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DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

China: Energy for Economic Expansion

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Directorate of Intelligence

July 1972

INTELLIGENCE MEMORANDUM**CHINA:
ENERGY FOR ECONOMIC EXPANSION****Conclusions**

1. Production of coal, petroleum, and electric power in the People's Republic of China (PRC) reached new heights in 1971. Rates of increase for petroleum and electric power continued apace, whereas the growth in coal output slowed. Estimates of production for 1971 and projections for 1975 are:

	<u>1970</u>	<u>1971</u>	<u>Increase in 1971^{a/}</u>	<u>Projected 1975</u>
Coal (million metric tons)	300	325	8%	450
Petroleum (million metric tons)	18	23	27%	45
Electric power (billion kilowatt hours)	60	70	18%	100
Thermal	46	55	19%	70
Hydro	14	15	7%	30

a. Based on unrounded data.

2. The use of primary energy (coal, petroleum, and hydroelectric power) in China is following the typical pattern for an industrializing nation. Coal remains the major source of primary energy -- accounting for 86.5%

Note: This memorandum was prepared by the Office of Economic Research.

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at present -- but during recent years the share accounted for by petroleum has grown steadily. China achieved self-sufficiency in petroleum and petroleum products in 1965 and subsequently has been expanding the capacity and technological versatility of the industry. Hydroelectric power also will continue to grow rapidly as new dams are completed, particularly in the Yangtze River Basin.

3. In striking contrast to Japan, which must import 90% of its energy requirements, China has the intention and the ability to maintain self-sufficiency in energy requirements. China has not only immense energy resources but also a vast and industrious labor force and a rapidly increasing capital plant devoted to the production of fuels and power. These factors, combined with effective government control over the allocation of energy resources, should provide ample supplies of energy during the remainder of the Fourth Five-Year Plan (1971-75).

Introduction

4. This memorandum discusses the production of primary energy* in China and its relation to China's general economic expansion. Recent developments in the coal, petroleum, and electric power industries are surveyed, and the present and future importance of each of these major energy sources is assessed. Finally, China's pattern of energy consumption is briefly compared with the pattern in other major countries. An appendix provides basic statistical information.

Discussion

5. China ranks third in the world in coal reserves, twelfth in petroleum reserves, and first in hydroelectric reserves. Although very little natural gas has been discovered so far, the potential for off-shore production of gas and oil appears promising.

6. Coal is by far the most important source of energy in China today. Petroleum resources have a high priority for development, and each year petroleum provides a larger share of the energy use pattern. Hydroelectric resources, which have remained relatively unexploited in the past, are now also under development. The pattern of production, as shown in Figure 1,

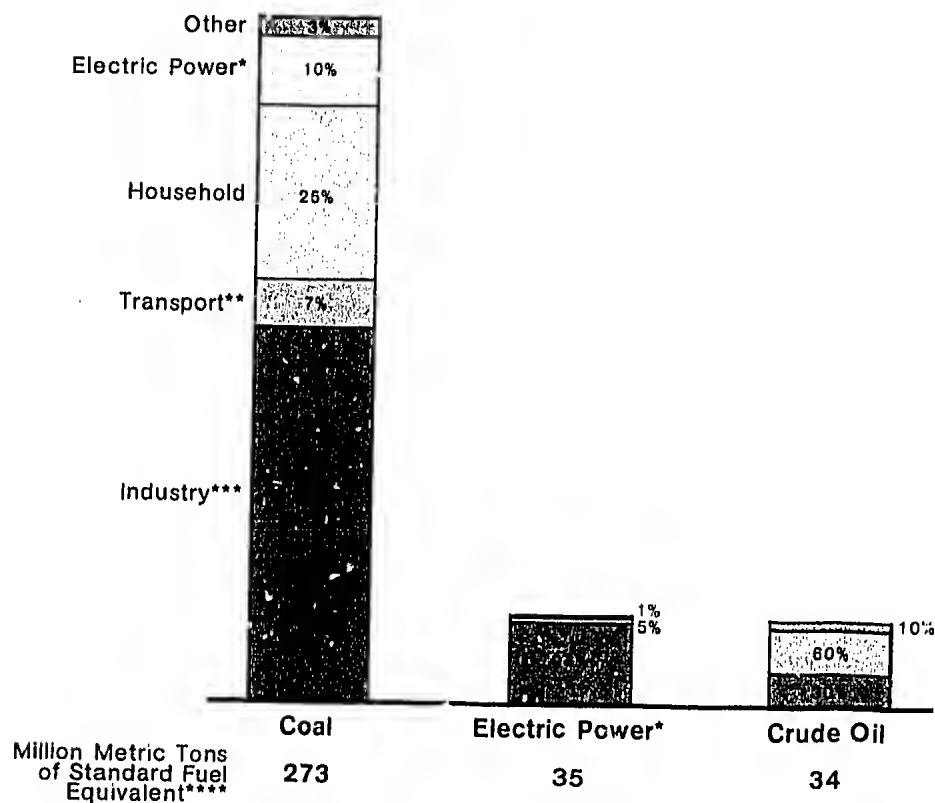
* Primary energy is energy derived from coal, petroleum, natural gas, hydroelectric power, and nuclear power. Thermal electric power is not considered primary energy because it is derived from coal, petroleum, or natural gas.

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reflects the dominance of coal and the priority of military-industrial expansion in the Chinese economy.

Figure 1

**China: Estimated Direct Consumption
of Fuel and Power in 1971**



*Electric power produced from coal is accounted for twice to show the prime source and end use.

**Including civil and military.

***Including military production and agriculture.

****Calorific value of 7,000 kilocalories per kilogram.

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The Coal Industry

Production in 1971

7. In 1971, coal production reached a record high of 325 million tons. This achievement was dimmed by a slowing of the rate of growth of production - 8% in 1971 compared with 20% in 1970. Two factors account for the slowdown:

a. First, by 1971 coal production had begun to push the limits of mine capacity. At the end of the year, the news media reported that various major mines had "topped their designed capacity of coal output by over 30%." An aggregate increase in production comparable to that of 1970 would have had to come from newly commissioned large mines, few of which were actually completed in 1971.

b. Second, a shift in emphasis from coal to minerals and metals, particularly to ferrous metals, resulted in a shift in allocation of machinery and materials that appeared to aggravate the chronic shortages of equipment and lumber in the coal industry. At the same time, ironically, increases in demand for metallurgical coal resulted from this favoring of the metals industries.

Small Mines

8. An unusually large part of the growth in the coal industry in 1971 was accounted for by small mines. In the past few years, small mines have enjoyed a vogue in the official press as part of a renewed campaign to make local areas less dependent on centrally allocated resources. Although the south is the region in which this new campaign has been pressed hardest, the use of small mines has spread to the major coal-producing provinces in the north. For example, 34% of the coal produced in Shansi Province is said to come from small mines. In the north the average "small mine" is larger and more mechanized than in the south. The Chinese appear to be consolidating and upgrading the quality of small mines throughout the country. The number of small coal mines in Kwangtung Province reportedly decreased 50% while their aggregate output rose 40%.

South of the Yangtze

9. The Chinese have continued to exploit more thoroughly the coal deposits in the south. The New China News Agency reported that "the nine provinces south of the Yangtze River produced 17% more coal this

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year than last, with the result that some formerly coal-short regions are now basically self-sufficient." The task of becoming "self-sufficient" in the south is easier because the concentration of industry has been lighter than in the north and because the temperate climate diminishes the need for industrial or household heating. As industry and population in the south continue to grow, however, known coal reserves will be inadequate for overall self-sufficiency.

Conservation Campaigns

10. The coal supply to Chinese households remains tight. The Yugoslav Broadcast Service reported recently: "before winter, piles of coal briquettes made of coal dust could be seen everywhere in Peking. In China anything usable as fuel including dry twigs, brushwood, and weed are collected actively everywhere." Businessmen attending trade fairs at Canton have noted that hotel rates go up in the winter because of heating costs and that hot water was available only in the morning.

11. Conservation drives to save coal are a recurrent feature of factory life in China. Throughout the year, factories and industrial plants report saving large quantities of coal through technological innovations or new control measures. Nor is the transportation sector neglected.

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Trade

12. China continues to export less than 1% of its coal production. Exports of anthracite coal to Japan fell off in 1971 partly because of a glut of anthracite coal in Japan and partly because of sizable Japanese imports from North Vietnam. Although Japan remains interested in buying coking coal, China has confined its exports of coking coal to North Korea. Peking has been reluctant to invest the expensive resources necessary for the expansion of capacity to produce coking coal. In view of the prominent role of the iron and steel industry in China's present economic development strategy, investment will soon have to be beefed up in this area.

Outlook for Coal

13. China's coal industry appears to be due for an active phase of development. The existing major mines appear to be unable to produce much beyond present levels of production, and the program for small mines appears to be approaching a point of diminishing returns. The Chinese have recently indicated a large number of projects in the coal industry are being

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speeded up. Many new starts on large mines have probably been made since the Cultural Revolution (1966-69), and a number of the new mines could be producing in 1972. Production of coal may reach 450 million tons by 1975 on the basis of combined increases from (a) the old large mines, (b) consolidated and refurbished small mines, and (c) a few new major mines.

The Petroleum Industry

Production in 1971

14. China produced an estimated 23 million tons of crude oil in 1971, or 27% more than in 1970. Ta-ch'ing, the major producing oilfield, accounted for more than half of total output - approximately 14 million tons. National output of crude has been increasing by roughly 30% per year for the past three years. Natural gas production, which is still negligible in China's overall energy balance, increased by 25%.

Recent Developments

15. The recent improvement in relations between China and the West in general, and the United States in particular, has kindled sharp foreign interest in China's petroleum industry, particularly in the potential for off-shore drilling. Prospects of finding sizable off-shore oil reserves are good. Various European countries, Japan, and the United States all envision a substantial market for sales of oilfield equipment and technology. Nonetheless, Peking has provided little basis for such enthusiasm. Large-scale development of deep-water, off-shore oil reserves is not an urgent matter, because present oil supplies are adequate for domestic needs for the foreseeable future. In any case, China has its own capability for off-shore production in shallow waters.

16. In 1971, Chinese petroleum industry drilling teams were said to have met their goals for feet drilled. The teams have continued to claim "technological success" in dealing with local conditions. One example has been the use of secondary recovery methods to maintain oilfield pressure. The Chinese claim to have maintained pressure at the Ta-ch'ing oilfield since 1960 through the use of water injection. When properly performed, water injection floats the oil remaining to be extracted upward while maintaining well pressure from below. Improperly performed, water injection forces water into producing wells and makes impossible the economic recovery of otherwise exploitable reserves. The Soviets encountered this problem in the Urals-Volga area where many large fields were ruined by over pressuring.

17. The Chinese have steadily benefited from the adoption and spread of Western technology in the petroleum industry. Domestic competence

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in the fundamentals of petroleum production and refining is improving with experience and with the increase in the number of trained technicians. At the same time, the Chinese continue to expand their knowledge of more advanced foreign techniques, in particular in the field of petrochemicals. In 1971, the Peking refinery, located about 35 miles outside the city, was opened up as a showpiece for foreign visitors (see Figure 2). It is a completely integrated refinery and includes a fluid catalytic cracking unit. Recent visitors have described it as being comparable in technical level to the best refineries in the United States 20 years ago.

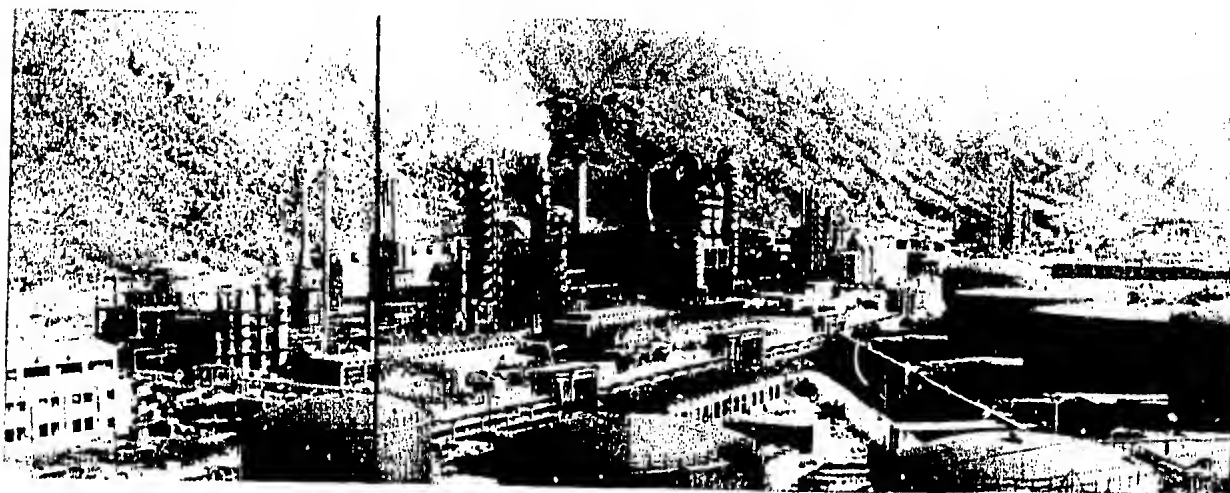


Figure 2. Peking Petroleum Refinery

Patterns of Petroleum Consumption

18. The defense sector has been the main beneficiary of increased petroleum output, with civil transportation next in priority. Many other sectors of the economy are also benefiting. The civil and military transport sectors are using more oil-powered air, sea, and land vehicles. The use of gas turbine electric generators signals a possible trend toward petroleum-fired electric powerplants on a selected basis. The use of petroleum products in agriculture is expanding from a small base, mainly because of the sizable increases in farm tractors and pumping equipment. The increase in the supply of petroleum is also being reflected in certain major urban areas where kerosene for household use is no longer rationed.

19. By the mid-1970s, substantial quantities of crude oil may be available for export. Foreign trade in petroleum, including both imports and exports, now amounts to about 2%-3% of total production. Oil exports in the past have been offered primarily for political purposes to such Chinese allies as Albania and North Korea.

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20. The PRC will continue to place a high priority on the oil industry's development. Demand for a wider range of products including petrochemicals is increasing each year. Several large new refineries are under construction, and the development of oilfields receives very high priority in the industrial expansion program. By 1975, production of crude oil could reach 45 million tons.

The Electric Power Industry

Production in 1971

21. Electric power production in 1971 increased 18% over 1970, reaching an estimated 70 billion kilowatt hours (kwh). Total powerplant capacity is estimated at approximately 19,200 megawatts (MW). Even though the rate of use of plant capacity increased significantly in 1971, the average remains low compared with rates of utilization in industrialized countries. The rate will be further raised when industrial complexes now under development are completed and when scattered power grids are integrated into regional and ultimately national networks.

Recent Developments

22. Construction of new large powerplants has been limited mainly to remote regions which previously had little or no generating capacity. For example, the PRC reported a 43% increase in the electric power production of Szechwan Province for 1971. Notable gains were made also in the outlying provinces of Kweichow, Ninghsia, and Tibet. Small urban powerplant construction projects and rural electrification programs continued throughout China during the year.

23. All provinces in the industrialized north and northeast reported sizable capacity increases at various powerplants during 1971 through reworking of equipment. In most cases, aging equipment was merely brought up to designed ratings; in other cases, plants appear to have exceeded designed capacity chiefly through improving cooling systems for generators.

Foreign Equipment

24. Over the past two years the Chinese have shown considerable interest in foreign-made electric generating equipment, and there has been talk of buying whole plants as well as component parts. In 1972, large rotary shafts and related products will be imported from Japan for use in 200-MW to 300-MW generators. Gas turbine generators are also of interest to the PRC. Five 20-MW units were purchased from the United Kingdom in 1971 (see Figure 3). Gas turbines are used for meeting peak load

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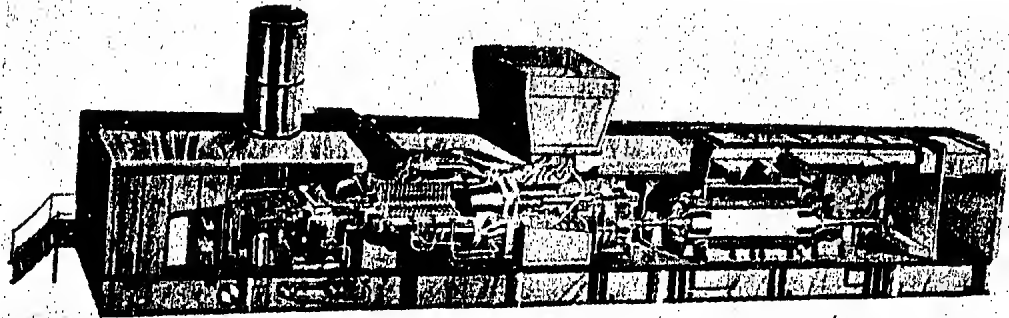


Figure 3. Heavy Duty Gas Turbine Set Similar to Those Being Built for China by Great Britain.

The sets comprise control equipment, turbine package, and alternator package. The complete units will be enclosed in a weatherproof casing mounted on a rigid steel baseplate.

requirements which are increasing in China's large urban areas. They may also be used temporarily for base load in isolated areas. The units can be installed in a short period of time because the powerplants at which they are installed require only minor structural modifications.

25. The rapidly rising demand for electric power may force the PRC to buy technically advanced equipment during the Fourth Five-Year Plan, and at present this market looks promising. The Chinese also intend to spur the domestic production of this equipment. Imports will diminish as metallurgical techniques are improved to meet the demanding specifications of modern generating equipment.

Outlook for Electric Power

26. By 1975, China should be producing at least 100 billion kwh per year, compared with the 70 billion kwh of 1971. This rate of growth would support an annual industrial growth rate of between 5% and 10%. Of the additional 30 billion kwh, about half is expected to come from thermal capacity and half from hydro capacity, mainly as the result of additions to capacity but also as the result of a higher rate of use of existing capacity. In the case of thermal electric power, the increase in capacity will take the form primarily of the installation of new generating units at large thermal plants built in the 1960s.

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27. The construction of both large and small hydroelectric projects is being accelerated during this five-year plan. Large hydroelectric projects will probably be concentrated in northwest and southwest China where much of the hydroelectric potential is undeveloped. An enormous project that appears to have started in 1970 is the damming of the Yangtze River at I-ch'ang in Hupeh Province. Plans for this high dam were formulated under the Nationalist regime and expanded by the Communists. The most conservative version of this plan calls for a 10,000-MW powerplant. By comparison, the largest plant in the world today is the 6,000-MW hydroelectric plant at Krasnoyarsk in Siberia.

28. Small rural electrification projects presently account for 16% of the country's total hydroelectric capacity. A typical rural power station which is run on the commune level or below has a capacity of less than 100 kilowatts. Some rural projects are as large as several megawatts, but most are quite small. Thousands of these stations are being set up throughout China.

Primary Energy

Percentage Shares

29. Historically, as the level of industrialization increases in a nation, petroleum and hydroelectric power assume more important roles as sources of primary energy. China is no exception. As shown in Table 1, the share of primary energy contributed by coal in the PRC decreased from 96.5% in 1955 to 86.5% in 1971. The dramatic drops in energy production in 1960-61 and 1967 reflect the decreases in coal production which occurred subsequent to the Leap Forward and during the Cultural Revolution. During the 1970s the rate of growth in output of crude oil and hydroelectric power will continue to outstrip the rate of growth in coal.

30. Nuclear power, an increasingly important source of primary energy in a number of other countries, has not yet been harnessed by the Chinese. The PRC has recently manifested interest in foreign technology for building nuclear powerplants; nevertheless, the regime appears to be years away from embarking upon a major effort in this area.

International Comparisons

31. To give further perspective to the energy use pattern in the PRC, a comparison of selected countries is shown in Table 2. The transition in the pattern of energy use can be seen in various stages of progression for the United States, the USSR, and India.

Table 1

China: Production of Coal,
Crude Oil, and Hydroelectric Power
in Terms of Primary Energy^a

Year	Percent				Million Metric Tons of Standard Fuel Equivalent ^b
	Coal	Crude Oil	Hydro	Total	
1955	96.5	1.5	2.0	100	94.7
1956	96.4	1.6	2.0	100	106.4
1957	96.1	1.7	2.2	100	126.5
1958	96.4	1.8	1.8	100	186.0
1959	95.8	2.2	2.0	100	234.9
1960	94.4	3.3	2.3	100	207.7
1961	91.6	4.5	3.9	100	144.8
1962	92.4	4.8	2.8	100	152.0
1963	92.8	4.8	2.4	100	172.0
1964	92.2	5.5	2.3	100	186.6
1965	92.2	5.8	2.0	100	205.2
1966	91.2	6.6	2.2	100	226.4
1967	88.6	8.1	3.3	100	184.4
1968	88.2	8.5	3.3	100	195.0
1969	89.0	8.7	2.3	100	241.5
1970	88.1	9.4	2.5	100	286.0
1971	86.5	10.9	2.6	100	315.0
1975	82.0	14.6	3.4	100	461.0

a. No records of fuelwood use are maintained in China.

b. A calorific value of 7,000 kilocalories per kilogram.

32. As indicated in Table 2, the energy ratio between China at present and the United States prior to World War I are strikingly similar. Certain other aspects of the Chinese economy are also similar to the US economy of that period. For example, railroads in the PRC still rely mainly on coal-fired steam locomotives. Household and industrial heat comes from coal, and household use of electric power is mainly restricted to lighting and concentrated in urban areas. Nevertheless, the great differences between

Table 2

A Comparison of Primary Energy Use Patterns
for Selected Countries

Country	Year	Percent					Metric Tons of Standard Fuel Equivalent Per Capita ^a
		Coal	Crude Oil	Gas	Hydro	Total	
China	1971	86.5	10.9	Insig.	2.6	100	0.4
United States	1906-10	86.5	7.5	3.4	2.6	100	5.5
	1970	20.1	43.0	32.8	4.1 ^b	100	12.0
USSR	1940	72.9	23.1	2.3	1.7	100	0.9
	1970	38.7	36.5	20.7	4.1 ^b	100	4.6
India	1971	58.7	31.7	Insig.	9.6	100	0.2

a. A calorific value of 7,000 kilocalories per kilogram.

b. Includes a small percentage of nuclear electric power.

the two time periods and countries limit the inferences that can be made about the future of China's energy industries on the basis of the US experience.

33. For example, the profound differences in per capita output, land use, and attitudes toward civilian consumption mean that the automobile will not play the same role in China as it has played in the United States. Also, as techniques for coal gasification become more economical, as hydroelectric resources are developed, and as nuclear power becomes more feasible, the importance of petroleum in the Chinese economy may not reach the level of importance now held by petroleum in the US economy.

Favorable International Position

34. China's position in energy resources is favorable on several counts. Reserves of coal, hydroelectric power, and petroleum are huge; their production now and over the next few years is likely to be adequate to meet China's growing needs; and the government maintains a rigorous system

of allocation of these resources to priority areas. Chinese energy resources may also become particularly important to Japan, which now imports 90% of its energy requirements. Japanese assistance in developing China's coal industry – analogous to current Japanese discussions with the Soviet Union concerning Siberian resources – remains a possibility both for improving China's coal supplies and for meeting Japanese requirements. Chinese petroleum supplies are also likely to continue to rise rapidly, and the PRC may soon be in a position to provide crude petroleum for increasing Japanese needs. In sum, the growing importance of trade relations between the PRC and Japan of the past few years may soon be further augmented by Chinese provision of energy resources to the Japanese economy.

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APPENDIX

Statistical Tables

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Table 3

China: Production of Coal,
Crude Oil, and Electric Power

<u>Year</u>	<u>Coal (Million Metric Tons)</u>	<u>Crude Oil (Million Metric Tons)</u>	<u>Electric Power (Billion Kilowatt Hours)</u>
1949	32.4	0.121	4.3
1950	42.9	0.200	4.6
1951	53.1	0.305	5.8
1952	66.5	0.436	7.3
1953	69.7	0.622	9.2
1954	83.7	0.789	11.0
1955	98.3	0.966	12.3
1956	110.4	1.163	16.6
1957	130.7	1.458	19.3
1958	230.0	2.300	28.0
1959	300.0	3.700	42.0
1960	280.0	4.600	47.0
1961	170.0	4.500	31.0
1962	180.0	5.000	30.0
1963	190.0	5.500	33.0
1964	200.0	6.900	36.0
1965	220.0	8.000	42.0
1966	240.0	10.000	47.0
1967	190.0	10.000	41.0
1968	200.0	11.000	44.0
1969	250.0	14.000	50.0
1970	300.0	18.000	60.0
1971	325.0	23.000	70.0

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Table 4

Comparisons of Coal, Crude Oil,
and Electric Power Production for China
and Selected Countries in 1971^a

Hard coal ^b	Million Metric Tons
United States	500
USSR	439
People's Republic of China	325
United Kingdom	150
Eastern Europe	185
India	69
Crude oil	Million Metric Tons
United States	470
USSR	377
Iran	227
Canada	66
People's Republic of China	23
Eastern Europe	17
Electric power	Billion Kilowatt Hours
United States	1,827
USSR	800
Japan	379
People's Republic of China	70
Australia	60
India	58

a. The first three countries in each group are the first, second, and third largest producers in the world.

b. Includes anthracite and bituminous coal.

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